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DEFENSE MAPPING AGENCY AEROSPACE CENTER ST LOUIS AFS MO  
STANDARDIZATION OF MAP SYMBOLS, (U)  
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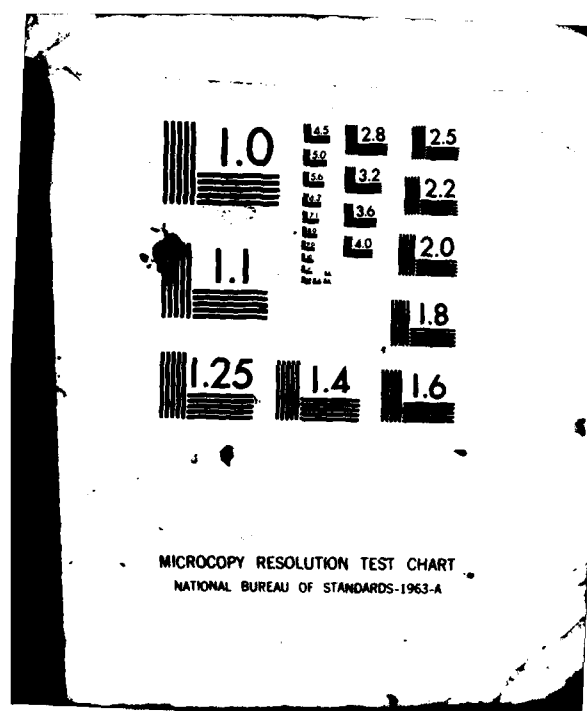
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## REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS  
BEFORE COMPLETING FORM

1. REPORT NUMBER

N/A

2. GOVT ACCESSION NO.

AD-A117530

3. RECIPIENT'S CATALOG NUMBER

N/A

4. TITLE (and Subtitle)

Standardization of Map Symbolology

5. TYPE OF REPORT &amp; PERIOD COVERED

N/A

6. PERFORMING ORG. REPORT NUMBER

N/A

7. AUTHOR(s)

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8. CONTRACT OR GRANT NUMBER(s)

N/A

9. PERFORMING ORGANIZATION NAME AND ADDRESS

Defense Mapping Agency Aerospace Center  
St. Louis AFS, MO 6311810. PROGRAM ELEMENT, PROJECT, TASK  
AREA & WORK UNIT NUMBERS

N/A

11. CONTROLLING OFFICE NAME AND ADDRESS

Defense Mapping Agency  
Washington, DC 20305

12. REPORT DATE

June 1982

13. NUMBER OF PAGES

6

14. MONITORING AGENCY NAME &amp; ADDRESS (if different from Controlling Office)

15. SECURITY CLASS. (of this report)

Unclassified

15a. DECLASSIFICATION/DOWNGRADING  
SCHEDULE16. DISTRIBUTION STATEMENT (of this Report)  
Distribution Unlimited

DISTRIBUTION STATEMENT A

Approved for public release;  
Distribution Unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

## 18. SUPPLEMENTARY NOTES

Prepared for presentation at the fall convention of the American Society of  
Photogrammetry at Hollywood, Florida during the period 19-23 September 1982.

## 19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Symbolology, standard, standardize, standardization, map, map symbology,  
engineering scale maps.

## 20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

In order to effectively communicate, man must have a common language. In the conventional or digital cartographic sphere, this axiom is no less true. Symbols form the language of cartography. Ideally, a worldwide standard set of symbols would solve many of the communication problems. But, this ideal solution is not technically feasible. However, within scale families of maps, standard symbology should be sought, especially in computer cartographic applications. This paper addresses the need for a standard for map symbology, particularly large scale maps, and suggests such a standard.

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EDITION OF 1 NOV 65 IS OBSOLETE

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

AD A117530

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## THE STANDARDIZATION OF MAP SYMBOLOGY

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### BIOGRAPHICAL SKETCH

Robert Jacober is a Major in the U.S. Air Force, and is currently working in the Advanced Systems Branch of the Defense Mapping Agency Aerospace Center as a Cartographic/Geodetic Staff Officer. He earned his Masters Degree in Geodetic Science from the Ohio State University in 1979. Major Jacober is a member of ASP and is serving on the Photogrammetric Standards Committee. He is a technical advisor to the Committee on Cartographic Surveying, Surveying and Mapping Division, of the American Society of Civil Engineers. Major Jacober has also been asked to serve as member of the National Committee for Digital Cartographic Data Standards, sponsored by the American Congress on Surveying and Mapping, to help determine the national standard for the symbology used on large scale maps, as a part of the overall national digital cartographic data base.

### ABSTRACT

In order to effectively communicate, man must have a common language. In the conventional or digital cartographic sphere, this axiom is no less true. Symbols form the language of cartography. Ideally, a worldwide standard set of symbols would solve many of the communication problems. But, this ideal solution is not technically feasible. However, within scale families of maps, standard symbology should be sought, especially in computer cartographic applications. This paper addresses the need for a standard for map symbology, particularly large scale maps, and suggests such a standard.

### INTRODUCTION

"It now appears...we need to work our way back to the simple universality of an understandable symbology..."  
(Dreyfuss, 1972)

"Here in the United States it is almost impossible to compare drawings prepared by different draftsmen, not only because they may be of different scales, but because the symbols used are often as far apart as the poles."  
(Wilkins, 1948)

"The kind of mapping that makes up at least 90% of the civil mapping is...the topographic and planimetric mapping for civil engineering, urban planning (micro), and architectural mapping...This mapping is done at scales of 1"-40'

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(1:480), 1"=50' (1:600), 1"=100' (1:1200) mostly...In the literature, there are a few chapters on mapping, and to make the work complete, there will usually be a page devoted to the reproduction of a list of cartographic symbols used on U.S. Geological Survey topographic quadrangles. As you know, the largest scale in the U.S.G.S. quads is 1"=2000' (1:24,000). It is easy to see that symbols for use at 1"-2000' are simply not applicable to scales 20 to 30 times larger..." (Steakley, 1977)

All three quotes strongly state the need for a set of symbols to unambiguously transmit an idea from a sender to a receiver. Mr. Dreyfuss addresses the need for worldwide standardization of symbols in general. Walter Blucher, in Mr. Wilkins' book, narrows the field to map symbology, and Mr. Steakley specifically identifies the symbology for very large scale maps. The phrase "very large scale maps" or "engineering scale maps" is defined by the author as maps from the scale 1"=20' (1:240) through 1"=400' (1:4800).

This paper will iterate the need for standard symbology used on very large scale maps and suggest a solution. The author has developed a prototype standard set of large scale map symbology and is exhorting the American Society of Photogrammetry (ASP) and the American Congress on Surveying and Mapping (ACSM) to adopt this standard as a point of departure, to modify and build on it as necessary, and push to have it accepted by the National Bureau of Standards (NBS) and the U.S. Geological Survey (USGS) as a national consensus standard.

#### WHY STANDARDIZE?

In order to effectively communicate, man must have a common language. In the conventional or digital cartographic sphere, this axiom is no less true. Symbols form the language of cartography. Ideally, a worldwide standard set of symbols would solve all of the communication problems. While it will go a long way, this ideal solution is not entirely feasible. On maps of scale 1"=40' (1:480), a large building, industrial complex or airport would be drawn to scale and not symbolized, whereas lamp posts, fire plugs, manhole covers and curbside storm drains could be shown as symbols. Reduce the scale to 1"=1000' (1:12,000) and the features represented by symbols on a large scale map probably would not (nor should they) be shown. The features that were drawn to scale at 1:480 would be symbolized. When the scale is reduced further to 1"=2000' (1:24,000), the airports, large industrial complexes, etc. cannot even be symbolized without drastically displacing other features on the map from their "true" locations. Though desirable, a single set of symbols will not always work. However, within scale families of maps; e.g., engineering scale maps as previously defined by the author, a standard set of symbols should be developed. Why hasn't this been done?

The absence of a standard set of symbols might, in part, be attributed to the absence of a federal organization that produces very large scale maps or has jurisdiction over the

many producers. Maps at the engineering scales are normally produced for the state, county, city, and private organizations; primarily for planning, construction, and maintenance at the local level, not at the continental level. Each organization has its own set of symbols. In many cases, city legends differ from county legends, which differ from the state legends. Each organization designs its own. That this multiplicity of symbols does, in fact, exist can easily be demonstrated by showing how many symbols the author found that represent lamp posts:

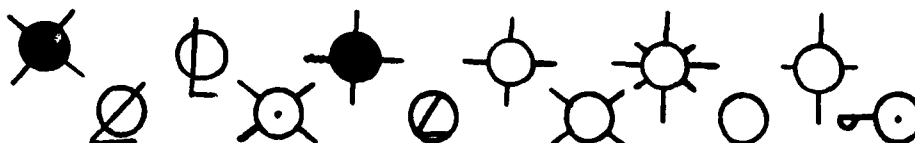


Figure 1. Free Standing Lamp Posts

or by listing all of the features the author found that are symbolized by a small open circle: manhole, light post, chimney, oil or gas well, sump, tanks of all types, airport taxiway light, tower, mill, and proposed location for trees. These two examples were compiled by examining a small sample of 103 legends.

#### DIGITAL REPRESENTATION

Large scale maps serve two general purposes. They are extremely efficient data storage media and they communicate facts. (Robinson and Petchenic, 1976). Automated (computer) cartography has tremendously increased the map's abilities to store and transmit information. The cartographic information may be stored in "layers" to facilitate retrieval, editing, updating, and displaying. Thus many paper maps may be composited into a single "digital map" in a computer's memory. For example, the digital display of utility systems within a city could include the water distribution system, electrical distribution grid, storm drain and sewer system, gas distribution network, cable TV routing, telephone network, and perhaps the roads and alleys. When displaying the separate layers, a fire plug, electrical tower, storm drain, manhole, cable TV tie in, telephone pole, and traffic signal all could be depicted as a small open circle without confusion. But, on a display of the combined "digital map", unless each network were coded in a different color, the symbols would have to be different or utter confusion would prevail. Additionally, separate symbology would have to be used to differentiate existing from proposed from abandoned or destroyed features.

The electronic map has the added benefit of being easily transmitted, nearly instantaneously, in digital format. As more and more producers and users of maps go digital, this quick and easy ability to interchange data will stimulate just such exchanges between cities, counties, states, educational facilities, and private organizations and will reinforce the need for standard symbology. Exclusive of the format of the information, a manhole represented by a circle in Cincinnati would be depicted by a circle in

New York, San Francisco, etc. Whether the computer is IBM, APPLE, UNIVAC, etc.; the software FORTRAN, BASIC, COBOL, etc.; the information binary, hexadecimal, octal, etc.; the depiction on the CRT (cathode ray tube) or hardcopy map generated from the digital data base must be the same, regardless of where or how the map is displayed. The need to transmit and use a different legend with each map reduces that map's effectiveness. Familiarity with a standard set of symbols increases the speed and reliability of map interpretation. As computerization progresses, automated scanning of hardcopy maps and automated pattern recognition of features on maps will become commonplace. The digital results will then be used as data bases from which to feed other map scales/requirements. This requirement for a standard data set alone makes the development imperative.

#### EFFORTS TOWARDS STANDARDIZATION

Many organizations and individuals have long and loudly voiced the need for a standard set of symbols to be used on the engineering scale maps. The Committee on Abbreviations and Symbols of the American Congress on Surveying and Mapping (ACSM), in 1979 reached the conclusion, "...that a complete interprofessional and interdisciplinary approach to the subject be obtained. This would have to be done by a fairly large, dedicated group, with proper funding. It could entail two or more years effort to compile the material, plus the preparation of a text or manual, with indices, cross-indices, and references. This would be a rather expensive undertaking". (Hammarstrom, Crudale, and Lewis, 1979).

Now the National Bureau of Standards has tasked the USGS to develop digital cartographic data standards. Since digitized data is essentially scaleless, very large scale map symbology will have to be addressed. The ACSM is working under a grant from the USGS to bring together representatives from the national, military, and educational communities and from the professional cartographic societies to ultimately develop a national Digital Cartographic Data Base. (Moellering, 1982). This initiative provides an appropriate framework within which to accomplish the standardization we see as necessary. One of the stated goals of the efforts should be a standard for the symbology used on very large scale maps.

#### A PROTOTYPE

As mentioned earlier, the beginnings of such a standard already exists. The author has been working on a prototype standard for engineering scale maps for the last four years. The initial research, including a recommended list of symbols and their use, is documented in the author's master's thesis. (Jacobson, 1979). The American Society of Civil Engineers (ASCE) has selected an updated version of this prototype legend for its member's use as an ASCE recommended standard. (Feldscher, 1980). The symbols and suggestions for their use will be printed in an upcoming ASCE publication, "Manual of Symbols, Scales and Accuracies".

for Engineering and Associated Purposes." Chapter V of this manual is devoted to the prototype standard. (Jacobser, 1980). This ASCE accepted version of the symbology is being put forth by the author, as a first step in the development of a national standard. It is by no means all inclusive or final. But it is a start, and it does offer suggestions on how many of the technical problems of implementing and using the standard can be overcome. Such a national standard will have to remain dynamic and flexible to accommodate the new symbols needed to represent the new features that technology will develop (e.g., space shuttle fuel storage tanks, interplanetary navigation aids, etc.) and that surveyors, engineers, and cartographers will have to portray.

I feel the new standard can be implemented rather easily. With the many years accumulation of irreplaceable manuscripts in files across the United States, recompiling maps using the new standard would be cost prohibitive and unnecessary. As long as legends are available for the filed maps, they remain valuable documents. But as new maps are produced, or old maps are revised or recompiled, the standard symbols should be used, especially on maps that are being compiled in digital format. Thus over a period of years, the new standard would be systematically implemented. (Jacobser, 1981).

#### RECOMMENDATION

The first step has been taken. A prototype has been designed. We in the American Society of Photogrammetry can recommend the prototype be accepted as the standard for the symbology used on very large scale maps. Several committees, most notably the Photogrammetric Standards Committee, will have a voice in preparing the Digital Cartographic Data Base standards, of which symbology is a part. The need for the standard exists. The vehicle to solve the problem is at hand. All we need do is climb aboard and collectively push for a standard that will be useful to the entire community. This is not to say the final solution will be easily obtained. Problems still remain to be faced. But the fact that a multiorganization committee now exists and is examining the problems gives hope. To implement the ASCE adopted symbology as a national standard will take the cooperation of the organization representatives on the committee and the backing of us all.

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